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**ELECTRIC VEHICLE
COUNCIL**

A BEST PRACTICE GUIDE FOR

Installing and Operating Public Electric Vehicle Charging Infrastructure

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EXECUTIVE SUMMARY

Best Practice Guide for Public Electric Vehicle Charging Infrastructure

As the electric vehicle (EV) market continues to grow in the U.S., so does infrastructure. According to the U.S. Department of Energy, there are (as of May 2021) 43,225 Level 2 (L2) charging stations and 6,049 direct current fast charging (DCFC) charging stations.¹

One 2019 analysis by the International Council on Clean Transportation (ICCT) found that at least 100,000 public and workplace chargers will be needed across the 100 most populous U.S. metropolitan areas by 2025, serving the more than 2.6 million new EVs expected by then in those areas.² These vehicles include both plug-in hybrid vehicles (PHEVs), which include both a battery and a gasoline internal combustion engine, and battery electric vehicles (BEVs). For this guide, they will be referred to collectively as EVs. In addition, the Biden administration has announced a goal of 500,000 charging ports across the country by 2030.

EV drivers do about 80% of their vehicle charging at home currently, but this is expected to change as the market continues to grow.³ There is growing



interest in the potential to develop public EV charging stations at workplaces, fuel stations, retailers, and other sites. Funding for infrastructure expansion at these kinds of sites is being provided by utilities, states, and localities, and \$15 billion is planned specifically to help achieve the Biden administration's 500,000 charger goal and as part of a larger \$2.3 trillion infrastructure package.⁴ The time may be now to take advantage of these opportunities. But what is involved? What do potential EV charging station site hosts need to know? What does it take to develop a successful project and what are the steps that need to be considered? These are the questions this guide is meant to address for potential site hosts without much knowledge about EV infrastructure or EV supply equipment (EVSE).

1 "Electric Vehicle Charging Station Locations," Alternative Fuels Data Center, U.S. Department of Energy, accessed May 6, 2021, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC&ev_levels=dc_fast&ev_levels=3.

2 Michael Nicholas, *Estimating Electric Vehicle Charging Infrastructure Costs Across Major U.S. Metropolitan Areas*, International Council on Clean Transportation, August 8, 2019, https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf.

3 "Charging at Home," Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, accessed May 4, 2021, <https://www.energy.gov/eere/electricvehicles/charging-home>.

4 Katie Fehrenbacher, "The Key Things to Know about Biden's EV Infrastructure Plan," *GreenBiz*, April 7, 2021, <https://www.greenbiz.com/article/key-things-know-about-bidens-ev-infrastructure-plan>.

There have been best practice guides developed by cities, non-governmental organizations (or NGOs), and others in the last several years, and they tend to address discrete issues (or discrete groups of issues, such as those involved in permitting). However, few address the questions and issues that site hosts are expected to encounter as they contemplate

public EV charging projects and even fewer do so in a holistic manner. This guide attempts to do just that. [Table 1](#) summarizes the issues addressed in this guide. To help illustrate different issues that may arise and share success stories in developing public EV charging stations, [short case studies](#) have been included at the end of this guide.

TABLE 1: SUMMARY OF CONSIDERATIONS FOR POTENTIAL SITE HOSTS

ASSESSING THE BUSINESS CASE	UTILITY ENGAGEMENT	AUTHORITY HAVING JURISDICTION (AHJ) ENGAGEMENT
<ul style="list-style-type: none"> <input type="checkbox"/> Assess the public policy environment. <input type="checkbox"/> Evaluate potential sites. <input type="checkbox"/> Assess which site host ownership model is preferred. <input type="checkbox"/> Assess what kind of charging the organization wants to provide and what hardware and software might be needed. <input type="checkbox"/> Estimate installation, operational, and maintenance costs. <input type="checkbox"/> Estimate insurance and warranty costs. <input type="checkbox"/> Project soft costs as best as possible. <input type="checkbox"/> Consider future-proofing. <input type="checkbox"/> Review available incentives from a state, a utility, the Volkswagen settlement, or AHJs. <input type="checkbox"/> Assess what kind of fees the organization wants/needs to charge. <input type="checkbox"/> Assess demand/return on investment (ROI). <input type="checkbox"/> As applicable, determine which party retains environmental attributes (credits) if/when they are generated. 	<ul style="list-style-type: none"> <input type="checkbox"/> Research what utilities in the AHJ are doing on EV charging and developing stations and whether they own stations. <input type="checkbox"/> Assess if the utility provides make-ready infrastructure. <input type="checkbox"/> Communicate early with the utility while assessing the business case to determine what it may need from the organization to plan any infrastructure upgrades. <input type="checkbox"/> Understand the utility’s interconnection requirements, timeline, and inspection process. <input type="checkbox"/> Research the utility’s fee structure. <input type="checkbox"/> Determine if a specific person/team can work with the organization through the project development process. <input type="checkbox"/> As applicable, determine which party retains environmental attributes (credits) if/when they are generated. 	<ul style="list-style-type: none"> <input type="checkbox"/> Determine which codes and ordinances apply to the site, including construction and electrical installation. <input type="checkbox"/> Research who is in charge of permitting at the AHJ, what permitting requirements are in place, and what the permitting timeline and process entail. <input type="checkbox"/> Research the AHJ’s expedited permitting process, if applicable. <input type="checkbox"/> Review the local AHJ require a site installation plan and anything else needed in the application submission package. <input type="checkbox"/> Research local zoning, building code, or parking requirements that need to be incorporated into the planning process. <input type="checkbox"/> Research any requirements governing the operation of EVSE.

Source: *Transport Energy Strategies*, October 2020

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What do they need to be thinking about as they consider whether and how to offer EV public charging? This best practice guide addresses these questions and, in particular, the following issues that tend to arise in three major categories:

- **Developing the business case:** This section covers questions and issues related to assessing the public policy environment in AHJs (such as states, cities, and counties), assessing the type of ownership model a site host may want to pursue, estimated costs (including planning for soft costs), and site selection, among other issues.
- **Utility engagement:** This section covers issues and questions related to working with utilities to develop EV charging station projects, including assessing interconnection issues, understanding the utility’s interconnection requirements and fee structure, and proactively engaging with utilities to successfully shepherd projects through the installation and commencement process.
- **AHJ engagement:** This section largely concerns the permitting process and working with the AHJ to successfully install and commence operation of the charging station project.



The EV market is expected to expand as automakers continue to add EV models to their lineups at different price points and infrastructure continues to expand, particularly DCFC.

ASSESSING THE BUSINESS CASE

Before beginning to develop the business case, review state requirements, especially if the state has addressed whether site hosts are treated as public utilities because they are selling electricity (thus potentially subjecting the site host to a complex regulatory system that is not necessarily intended for them).

More than 30 states have addressed this issue and clarified that site hosts are not public utilities and thus are not subject to regulations governing that industry. Getting a sense of the overall public policy environment and how that might impact the site host’s business case and station development plan is important. Some states have set no policies governing EVSE at all while other states, such as California, have an active and continually evolving regulatory environment. See: Fuels Institute, EV Market Regulatory Report, March 2021, available at <https://www.fuelsinstitute.org/Research/Reports/EV-Market-Regulatory-Report>.



KEY QUESTIONS

- What is the public policy environment in the AHJ?
- What kind of site host ownership model works best for your organization?
- What kind of charging do you want to provide (for example, L2, DCFC) and what kind of fees do you want to charge?
- What kind of chargers do you want to install (L2, DCFC)? What kind of other equipment might you need?
- How do you select an appropriate site?
- What are your estimated installation and operational costs, particularly in an owner-operator business model?
- Have you budgeted for or considered unexpected or soft costs?
- Do you want to future-proof your site?
- Are there incentives available, such as from the state or utility, that may apply to your project?
- What is the projected demand and what kind of vehicles/connector will you target?

TYPICAL SITE HOST BUSINESS MODELS

There are generally two site host business models for EV charging:

- Owner-operator:** The site host purchases the EVSE from a charging service provider (CSP) and then works with a separate contractor to install it. The owner-operator has the sole responsibility for the charging station’s operation, maintenance, and utility interconnection. However, the CSP offers warranties covering repair and replacement of parts and assistance with issues that may arise in coordinating with utilities. The owner-operator may need or want to purchase network access software that allows them to efficiently track station usage, make their station locatable via mobile app-based software, and manage pricing and customer payment.
- Third-party owner-operators:** A third party installs, operates, and maintains the charging station. It collects revenues directly from the use of the station and may charge membership fees for access to their network of stations. Third-party owner-operators generally lease space in a host’s parking lot and remit a fee or revenue share from the charging station to the site host. Under this scenario, the third-party operator will likely own any and all environmental attributes that are used to gain state or federal credits and/or incentives. Companies involved in third-party owner-operator charging include Tesla, EVgo, Electrify America, ChargePoint, EV Connect, Blink Charging, and Greenlots.

Each model has advantages and disadvantages ([Table 2](#)).⁶

Fee structures generally fall into three categories:

- No fee: Charging is offered for free to customers solely as an amenity; for example, some workplaces may offer free EV charging. Note: This is usually seen with L2 and can be abused if time limits cannot be enforced and people can leave their vehicle for hours or overnight.**
- Nominal fee to cover costs: Fees are set high enough to recoup operational and/or installation costs and insulate the owner-operator from spikes in costs from increased utilization, such as from demand charges (see utility engagement section, below). Fees are typically set as a price per kilowatt-hour (kWh).**
- Profit center: The fee for charging is designed to turn a profit from the sale of charging services. Fees are typically set as a price per kWh delivered, per unit of time, or per charging session. Fee structures are usually considered only through the lens of what works best for the site host’s business strategy.**

EV charging is not harmonized across the U.S. and is usually found through digital formats (network apps or navigation/maps). Thus, “price sign” perceptions, as seen with liquid fuel, is not usually a consideration. This could change in the future when the methodology for pricing EV charging is harmonized across the U.S. and digital format price displays become better understood.

⁶ Charles Satterfield and Nick Nigro, *Public EV Charging Business Models for Retail Site Hosts: A Financial Analysis of Common EV Charging Business Models for Retail Site Hosts* (Washington, DC: EV Atlas Public Policy, April 2020), 5–9, <https://atlaspolicy.com/wp-content/uploads/2020/04/Public-EV-Charging-Business-Models-for-Retail-Site-Hosts.pdf>.

TABLE 2: ADVANTAGES AND DISADVANTAGE OF SITE HOST BUSINESS MODELS

BUSINESS MODEL	DEFINITION	ADVANTAGES	DISADVANTAGES
<p>Owner-operator</p>	<p>The site host purchases the EVSE from a CSP and then works with a separate contractor to install it.</p> <p>The site host is solely responsible for the utility interconnection, operation, and maintenance of the station</p>	<ul style="list-style-type: none"> The owner-operator controls the pricing structure for the station and receives revenue from the station, which may be significant. The owner-operator can directly optimize and oversee the customer experience, ensuring it aligns with its corporate brand and goals. Potential for developing an additional revenue stream from the charging station(s). The owner-operator may benefit from additional sales revenue from new customers and/or customers that spend more time in stores. EVSE may enhance corporate branding and align with the owner-operator’s sustainability goals. Would own the environmental attributes, as applicable (such as credits generated under regulatory programs). 	<ul style="list-style-type: none"> The owner-operator is solely responsible for ensuring the successful development, installation, and maintenance of the station as well as coordinating with the utility on interconnection and other issues that may arise with the station. The owner-operator is taking on both technology and market risk. This may be cumbersome for owner-operators who are not familiar with the processes involved. The owner-operator may need deeper knowledge of electricity rate structures if the station is running off the site host’s electricity meter. Optimizing the pricing structure as balanced against electricity demand can be challenging.
<p>Third-party owner-operators</p>	<p>The third party installs, operates, and maintains the charging station.</p> <p>It collects revenues directly from the use of the station and may charge membership fees for access to their network of stations.</p> <p>Third-party owner-operators generally lease space in a host’s parking lot and remit a fee or revenue share from the charging station.</p>	<ul style="list-style-type: none"> The third-party owner-operator takes on the task of developing the site, including obtaining all necessary permits) and are well-versed and experienced in what to expect in the development, installation, and operation process. Limits the site host’s exposure to cost overruns, maintenance issues, and potentially complicated utility interconnections. May provide a consistent stream of revenue to the site host, whether or not the station is ultimately profitable. The site host may benefit from additional sales revenue from new customers and/or customers that spend more time in stores. Hosting EVSE may enhance corporate branding and align with the site host’s sustainability goals. As applicable, determine which party retains environmental attributes (credits) if/when they are generated. 	<ul style="list-style-type: none"> The site host ultimately relinquishes control over the customer experience and the consistency of that experience. However, lease agreements can address issues such as maintenance, appearance, uptime, and fee structures. The site host does not realize the full revenue potential the charging station represents. The site host may not own or fully own the environmental attributes, as applicable (such as credits generated under regulatory programs) – that would need to be negotiated with the third-party owner-operator.

Source: Atlas Public Policy, April 2020

SITE SELECTION CONSIDERATIONS

The site host may need to consider a number of factors when selecting a site and may use public or proprietary data to analyze potential sites that are likely to receive high utilization:

- EV adoption in the surrounding area (viewed through connector type: Tesla, CCS, or CHAdeMO)
- Driver travel patterns
- Proximity to major roads and highways
- Nearby services and amenities (retail stores, coffee shops, ATMs, restrooms/rest areas)
- The status and type (L2 or DCFC and what level of DCFC) of existing charging sites that may be close to the location⁷
- Dwell time compared to charging type (Will drivers be there for hours or 10-20 minutes?)



Site hosts may also consider factors such as:⁸

- Safety at a site
- Wi-Fi capability for DCFC
- Appropriate lighting for charging at night
- Adequate space to meet the site host's requirements and comply with Americans with Disabilities Act (ADA) requirements (see section on "Complying with ADA Requirements")
- Utility interconnection, which could add considerable cost when trenching and/or upgrades are required
- Electrical capacity at the site as well as excess electrical capacity or well-located electrical service
- The local utility capacity and if there is sufficient voltage and amperage to power the charging station
- Whether on-site battery storage for power emergency back-up, demand charge leveling (see section on "Rates and Demand Charges from Utilities"), or other use is needed

A final factor is where at a site EV charging may be located: Prime parking spaces are often far from the electrical panel, which is commonly located at the back of a building. Trenching, running additional conduit, and replacing paving to installing EVSE in these spaces can be very expensive. Additionally, internal combustion engine (ICE) vehicles will occupy prime spots sometimes. On the other hand, locating charging in hidden spaces behind buildings or a significant distance from amenities may be perceived by drivers as unsafe.

⁷ Public sources to value existing locations include the U.S. Department of Energy at https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC and PlugShare at <https://www.plugshare.com/>.

⁸ California Governor's Office of Business and Economic Development, *Electric Vehicle Charging Station Permitting Guidebook*, July 1, 2019, 8, <https://businessportal.ca.gov/wp-content/uploads/2019/07/GoBIZ-EVCharging-Guidebook.pdf>.

COST CONSIDERATIONS IN ASSESSING THE BUSINESS CASE

Site hosts in the owner-operator model will need to budget for items including:

- Potentially acquiring or leasing property
- Hardware and software
- Network access contracts
- Cable costs
- Potential grid upgrades and other costs related to utility interconnection
- Depending on the jurisdiction, card readers to allow consumers to pay for their charging session by credit card
- Compliance with regulations such as the ADA
- Installation construction costs
- Maintenance, maintenance contracts, warranties, and associated costs
- Customer care costs with dedicated and trained representatives who would ideally have access to the charging network to troubleshoot and work with customers to resolve any issues that may arise

GRID UPGRADES

Grid power capacity at a site, or hosting capacity, can generally host a 50 kW DCFC station or several L2 chargers operating simultaneously. But at higher demand levels, the site may require upgraded power grid capacity increases, which may mean upgrading a distribution transformer. For sites with power demand in the range of one megawatt (MW) or higher, it may also be necessary to upgrade the distribution grid feeder supplying the transformer.⁹ Costs can range from \$35,000 to \$173,000 depending

on what might be required at a site.¹⁰ Ask early in the site evaluation what the available capacity is, whether system upgrades may be required, and whether the utility will share the cost of the upgrade (some will in certain cases).

TYPES OF CHARGING EQUIPMENT AND COSTS

Chargers are generally classified in terms of the power they can provide, designated as levels:




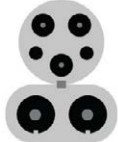

- **Level 1 (L1) charging** uses a standard 120 V alternating current (AC) electric circuit.
- **L2 charging** uses a 208/240 V AC electric circuit.
- **DCFC, sometimes referred to as a L3 DC charging**, uses a three-phase 480 V AC electric circuit but delivers direct current (DC) to the vehicle.

Chargers are also classified by the kind of connector on the charging cord. There are currently two competing standards sold in the U.S.: SAE J1772, developed by SAE International, and CHAdeMO, developed by an organization of the same name. The SAE J1772 standard covers both AC (J1772) and DC (J1772-CCS) charging while the CHAdeMO connector is only used for DCFC charging. Many charging stations use the SAE Combo connector, which allows for L2 and DCFC across a wider range of automaker EV models. Tesla also has a proprietary connector for their charging stations exclusively available to Tesla drivers and provides adapters to the J1772 and the CHAdeMo connectors. [Table 3](#) summarizes these three types of charging, their connectors, and other characteristics. Note that miles of range and time to a full charge will depend on the range of the vehicle and charger. Cost ranges for this hardware is summarized in [Table 4](#). Standardization of cords and connectors is an ongoing issue for DCFC.

⁹ April Bolduc et al., *Utility Best Practices for EV Infrastructure Deployment* (Washington, DC: Smart Electric Power Alliance, June 2020), <https://sepapower.org/resource/best-practices-for-utility-ev-infrastructure-deployment/>. See also: Chris Nelder and Emily Rogers, *Reducing EV Charging Infrastructure Costs* (Boulder, CO: Rocky Mountain Institute, 2019), <https://rmi.org/ev-charging-costs>.

¹⁰ Nelder and Rogers, *Reducing EV Charging Infrastructure Costs*, 22.

TABLE 3: COMPARISON OF L1, L2, AND DCFC CHARACTERISTICS

CHARACTERISTIC	L1	L2	DCFC
Types of plugs/ connectors			  
CONNECTOR STANDARD	SAE J1772	SAE J1772	CHADEMO SAE COMBO TESLA
Power levels (installed circuit rating)	110/120 volts alternating current (VAC) at 15 or 20 amps	208/240 VAC at 20 amps 208/240 VAC at 40 amps 208/240 VAC at 50 amps 208/240 VAC at 100 amps	440 or 480 VAC at 100+ amps
Miles of range restored per hour of charge	5 miles	13-25 miles	30-40 minutes for a full charge
Time to a full charge	8-12 hours	3-6 hours	
Common charge locations	Home, workplace	Home, workplace, public station	Public station or commercial depot
EV manufacturers	Audi, BMW, Daimler, Ford, General Motors, Hyundai, Jaguar, Porsche, Volvo, and Volkswagen	CHAdeMO: Nissan, Mitsubishi, and Kia	CHAdeMO: Nissan, Mitsubishi, and Kia SAE Combo: Audi, BMW, Daimler, Ford, General Motors, Hyundai, Porsche, Volvo, and Volkswagen Tesla: Proprietary adapter for Tesla vehicles only

Compiled by Transport Energy Strategies citing “How to Charge a Tesla: The Complete Guide,” Autopilot Review, <https://www.autopilotreview.com/how-to-charge-a-tesla/>. Other material adapted from NC Clean Energy Center, Fact Sheet: Electric Vehicle Charging, January 2020, available at <https://nccleantech.ncsu.edu/wp-content/uploads/2020/03/Fact-Sheet-NC-EV-Charging.pdf>.

TABLE 4: COST RANGES FOR CHARGING INFRASTRUCTURE COMPONENTS

COST ELEMENT	LOWEST COST	HIGHEST COST
L2 commercial charger	\$2,500 (7.7 kW)	\$4,900 (16.8 kW); outlier: \$7,210 (14.4 kW)
DCFC (50 kW)	\$20,000	\$35,800
DCFC (150 kW)	\$75,600	\$100,000
DCFC (350 kW)	\$128,000	\$150,000
Transformer (150–300 kilovolt ampere (kVA))	\$35,000	\$53,000
Transformer (500–750 kVA)	\$44,000	\$69,600
Transformer (1,000+ kVA)	\$66,000	\$173,000
Data contracts	\$84/year/charger	\$240/year/charger
Network contracts	\$200/year/charger	\$250/year/charger
Credit card reader	\$325	\$1,000
Cable cost	\$1,500	\$3,500

Source: Rocky Mountain Institute, 2019; see also Nelder and Rogers, *Reducing EV Charging Infrastructure Costs*, 18.

[Table 4](#) provides a range of costs for L2 and DCFC chargers, transformers, data contracts, network contracts, credit card readers, and cable costs.

The EV Charging Financial Analysis Tool, a publicly available financial analysis tool based in Excel, may help in evaluating the potential financial performance of EV charging projects.¹¹ The tool can evaluate a variety of business arrangements and use the discounted cash flow method to evaluate the financial performance of a charging project through a variety of revenue streams over the lifetime of the charging equipment.

The early phases of EV adoption may represent a point in time where there is very little return on EVSE investments, but that is expected to change as adoption grows. The business case will need to be continually reassessed and the ROI analyzed and include a review of which ownership model suits the business goals best.

TYPES OF MAINTENANCE

General maintenance for EVSE includes storing charging cables securely, checking parts periodically, and keeping the equipment clean.¹² Chargers may need intermittent repairs as well. Warranty pricing varies by manufacturer, including plans that are fixed term, renewable, and included with equipment costs. While ongoing EVSE maintenance can be minimal, repairing broken chargers can be costly if they are no longer under warranty. Therefore, it is important to establish responsibility for maintenance costs and determine if the site host, charging network, or installer is responsible.

While actual maintenance costs vary, station owners should estimate annual maintenance costs of \$400 per EVSE. Most networks also offer a maintenance plan for an additional annual fee. EVSE generally lasts about 10 years.

¹¹ Atlas Public Policy continues to update the EV Charging Financial Analysis Tool, starting with Version 2.0, available at <https://atlaspolicy.com/rand/ev-charging-financial-analysis-tool/>.

¹² “Charging Infrastructure Operation and Maintenance,” Alternative Fuels Data Center, U.S. Department of Energy, https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html.



RATES AND DEMAND CHARGES FROM UTILITIES

Site hosts should contact the local utility to review the options for rate structure and any implications of using charging rates or time-of-use (TOU) rates at the site.¹³ In general, the annual electricity consumption cost for an owner-operator is determined based on the electricity rate measured in dollars per kWh (\$/kWh) and the amount of electricity consumed. In addition to electricity costs based on energy consumption, site hosts may be subject to power demand charges from the utility because of the additional consumption from charging.

Some commercial and industrial electricity customers have higher electricity demand, and this can be taxing on the electric distribution system, requiring the utility to operate additional equipment to manage the higher electric load.¹⁴ As a result, utilities may bill their commercial and industrial an additional demand charge based on the highest peak demand for power capacity within each billing period. The case study on “EVgo and the Effective kWh Price for Electricity” provides a real-world example of the impact of demand charges on EV charging.

An Idaho National Laboratory study showed that demand charges can increase a site host’s monthly utility bill by as much as four times ranging from \$0 to more than \$2,000 per month.¹⁵

These charges can be managed or reduced by strategically managing the EVSE energy consumption such as charging at off-peak times or staggering vehicle charging during high consumption periods. The site host should talk with the utility at the outset of the project about whether there are ways to minimize demand charges.

A common way to manage demand charges is through the utility’s TOU tariff, which helps drivers minimize the cost of recharging by charging when electricity costs are low and avoiding charging when they are high.¹⁶ Another form of managed charging is turning down the rate of charging or turning the charger off entirely when grid conditions are constrained, or when directed by a demand response signal from the utility.

A second possibility that may emerge in the coming years is on-site battery storage. According to a report from McKinsey, these batteries can charge and discharge using DC and connect to the grid through a large inverter.¹⁷ They can then charge from the grid at times when costs are lower, store the power, and release it when demand is higher (a practice known as peak shaving). When a car arrives, the battery can deliver electricity at 150 kW without drawing power from the grid. If two vehicles arrive, one can get power from the battery and the other from the grid. In either case, the economics improve because the cost of both the electricity itself and the demand charges are greatly reduced. Such a solution is dependent on the price decline for batteries.

13 Margaret Smith and Jonathan Castellano, *Costs Associated with Non-Residential Electric Vehicle Supply Equipment*, prepared by New West Technologies LLC, (Washington, DC: U.S. Department of Energy, November 2015), https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf.

14 Dane McFarlane and Matt Prorok, “Analysis: How Demand Charges Impact Electric Vehicle Fast Charging Infrastructure,” Great Plains Institute, July 31, 2019, <https://www.betterenergy.org/blog/demand-charges-and-dcfc/>.

15 The EV Project, *What is the Impact of Utility Demand Charges on a DCFC Host?*, (Idaho Falls, ID: Idaho National Laboratory), June 2015, publication reference number INL/EXT-15-35706, <https://avt.inl.gov/sites/default/files/pdf/EVProj/EffectOfDemandChargesOnDCFCHosts.pdf>.

16 Nelder and Rogers, *Reducing EV Charging Infrastructure Costs*, 19.

17 Stefan Knupfer, Jesse Noffsinger, and Shivika Sahdev, *How Battery Storage Can Help Charge the Electric Vehicle Market* (McKinsey Center for Future Mobility, February 2018), <https://ipu.msu.edu/wp-content/uploads/2018/03/McKinsey-Battery-Storage-2018.pdf>.

BEWARE OF SOFT COSTS

While hardware costs are declining, a 2019 study by Rocky Mountain Institute (RMI) found that soft costs could be responsible for charging station installation costs that are three to five times more than the costs of the hardware for a project. Such costs can serve to imperil a project, according to the report.¹⁸ Examples of soft costs include:

- Poor communication with utilities, leading to time delays and cost increases centered around such issues as understanding the utility’s available capacity to add new loads to a distribution network at a prospective site and/or the process of obtaining a utility interconnection.
- If easements are required, the approval process could be lengthy, time consuming, and add to a project cost.
- The complexity of the permitting process can be time consuming and costly, depending on the jurisdiction. The RMI project provides an example: “If a single [EV service provider (EVSP)] wanted to install 20 chargers in 10 different jurisdictions, it would have to go through 10 unique permitting processes and potentially modify its designs 10 different ways to ensure that they complied with local regulations.”¹⁹
- At sites where increased charging needs may be anticipated in the future, owner-operators may choose to front-load investment and install excess capacity in the make-ready elements when installing the first set of chargers. There may be more upfront cost that would need to be balanced against future savings.

- The need to evaluate several locations before selecting the final site for the charging station, which would include the time and costs associated with exploring utility interconnection options, developing engineering plans, identifying permitting requirements, and completing other work related to the project.
- Planning for and complying with ADA requirements at a site.

Planning and budgeting for soft costs such as these can help facilitate the successful completion of a project. There are other strategies as well, suggested by the RMI, that include:

- Seek larger procurements where there is a reasonable expectation of being able to deploy the equipment within a year or two, if the cost of storing the equipment until it is needed is not prohibitive.
- Grouping more chargers at a single site where feasible instead of dispersing them across multiple sites can spread the fixed costs such as site preparation and utility interconnection across more chargers and reduce the number of sites that maintenance personnel must visit.
- Choose the location of the chargers at the site carefully and be aware of the distance between the chargers and the nearest utility interconnection point. Trenching to lay conduit is one of the largest costs for public charging sites.
- Install charging infrastructure as part of a new building or parking facility construction project or during a major facility upgrade to future-proof a site and potentially reduce installation costs down the road. This may ultimately reduce the time and cost to permit these sites when the site host is ready to offer EV charging.

¹⁸ Levy, Riu, and Zoi, *The Costs of EV Fast Charging Infrastructure and Economic Benefits to Rapid Scale-Up*, 9.

¹⁹ Levy, Riu, and Zoi, *The Costs of EV Fast Charging Infrastructure and Economic Benefits to Rapid Scale-Up*, 33.

Site hosts may be eligible for incentive funds as many states look to expand EV charging infrastructure in government, business, and public places.

PREPARING FOR EV-READY AND EV-CAPABLE BUILDING CODES

Three states (California, Oregon, and Washington) and more than 20 local AHJs have implemented EV-ready building codes that require a certain percentage of parking spaces in residential, multiunit dwellings, and commercial buildings to be EV ready and/or EV capable.²⁰ These terms are defined as follows:

- **EV-ready spaces:** Full circuit installations include 208/240 V, 40 amp panel capacity, raceway, wiring, receptacle, and overprotection devices similar to a dryer circuit.
- **EV-capable spaces:** Panel capacity and the conduit (raceway) are installed to accommodate the future build-out of EV charging with 208/240 V, 40 amp circuits.

The 2021 International Energy Conservation Code model code will include EV-ready provisions for residential, multiunit dwellings, and commercial buildings (Groups A, B, E, I, M, S-2). For the latter,

two EV-ready parking spaces and EV-capable infrastructure (the electrical panel capacity and raceway, but not wiring) for 20% of the total parking spaces are included in the code.

CHECK FOR INCENTIVES

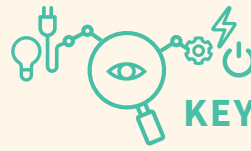
Another important factor for planning and budgeting are incentives available at the local and state levels, as well as through utilities, that may apply to site hosts. Recent EV Council research notes that 24 states currently offer incentives to expand public charging. These incentives are in addition to those offered by utilities and through Volkswagen settlement funds being disbursed to the states. At least 34 states plan to use 15% of their settlement funds (the maximum allocation) to fund EV charging projects. Site hosts may be eligible for these funds as many states look to expand EV charging infrastructure in government, business, and public places. In addition, utilities in 21 states currently offer incentives for charging that may be applicable to site hosts.

²⁰ "EV Infrastructure Building Codes: Adoption Toolkit," Southwest Energy Efficiency Project (SWEET), <https://www.swenergy.org/transportation/electric-vehicles/building-codes#requirements>. SWEET is tracking these developments on an ongoing basis.

UTILITY ENGAGEMENT

As the foregoing section on “Cost Considerations in Assessing the Business Case” shows, utility engagement, particularly at the outset of a project, can be critical to the success of a charging station project. It is critical to understand when contemplating a project what the utility is doing in a particular area on electrification.

As noted earlier, some utilities are providing incentives to develop public charging stations, providing make-ready infrastructure to support charging station projects, and/or developing their own charging station networks. It may be less advantageous to develop charging station sites in areas where utilities own charging station networks.

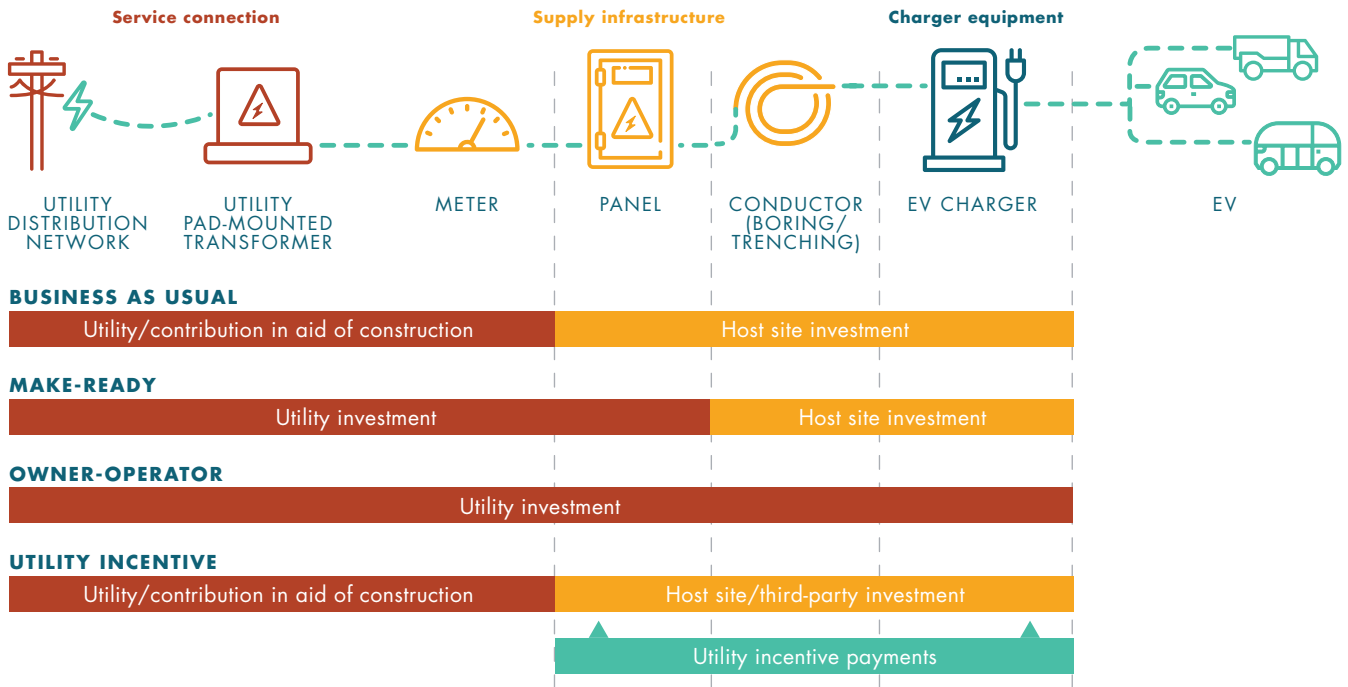


KEY QUESTIONS

- What are utilities doing in charging in your area? Do they own charging stations? Do they provide make-ready infrastructure? What is their business model and how does it align with yours?
- What does the utility need from your organization to plan infrastructure (for example, site plan, etc.)?
- What are the utility’s interconnection requirements, timeline, and inspection process?
- What is the electricity fee structure (for example, demand charges, TOU, etc.)?
- Who is in charge of interfacing with site hosts and charging companies at the utility?



FIGURE 2: MODELS OF UTILITY INVESTMENT IN EV CHARGING INFRASTRUCTURE

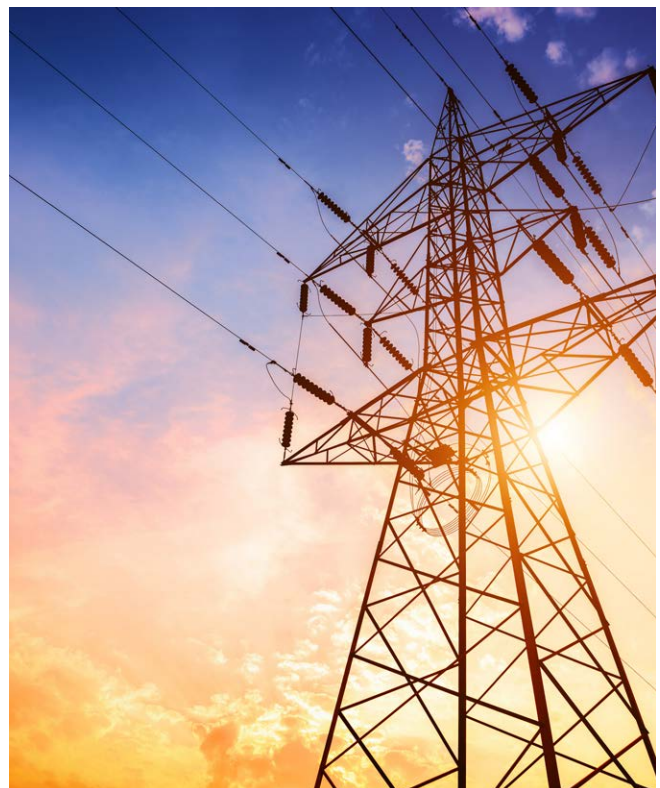


Source: Smart Electric Power Alliance (SEPA), citing M.J. Bradley & Associates, 2019

MAKE-READY INFRASTRUCTURE

Make-ready infrastructure means the utility funds, owns, designs, and installs all electrical and civil infrastructure on both sides of the meter for EV charging (including conduit, wiring, disconnects, switchgear, electrical panels, concrete pads, and the associated installation activities, including trenching, boring, and repaving), except for the chargers provided by the customer. Contribution payments may be required from program participants. A number of utilities are increasingly providing or committing to provide make-ready infrastructure for charging stations. See [Figure 2](#) for an illustration of different ways utilities are investing in EV charging infrastructure.

Consulting with the local utility at the outset of a project, even before the business case is developed, is important to assess not only the type of work that



Getting a sense of a utility's interconnection requirements and timeline is critical as site hosts plan for a project and understand what a final inspection process entails.

may need to be conducted at a potential site(s) but what documentation the utility might need from the owner-operator. Utilities around the country are beginning to set up teams and/or specific contacts to assist site hosts in developing charging station projects.²¹ It is critical to ask for feedback about the available capacity at a site and what has or might trigger system upgrades. Such documentation may include:

- A customer project information sheet, including:
 - Contact information (for the host customer and contractor)
 - A legal contact for contracting
 - Scope of project (for example, equipment type Level 2 and/or DCFC, make/model of equipment)
 - Panel size
 - Service voltage and phase
- A design option letter authorizing the design of the charging infrastructure and any required service extension
- A PDF file of and/or computer-aided design site plan
- A load calculation
- An electrical panel single-line diagram
- Customer preferences for combined or separate metering of EV charging
- Other information sometimes requested by utilities in rebate programs, including project type, charging network, project costs, and a copy of the business license (if applicable)²²

Getting a sense of a utility's interconnection requirements and timeline is critical as site hosts plan for a project and understand what a final inspection process entails (if needed).

21. Bolduc et al., *Utility Best Practices for EV Infrastructure Deployment*, 30.

22. Bolduc et al., *Utility Best Practices for EV Infrastructure Deployment*, 41.

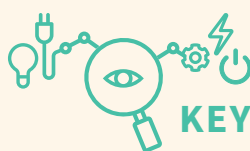
AHJ ENGAGEMENT AND INSTALLATION CONSIDERATIONS

At the outset, it is critical to engage with the AHJ, generally a city or county, to determine the necessary permit(s), any special permitting requirements or processes for EV charging stations, the necessary paperwork for the application package, and the approval timeline.

A site host may need to comply with other state and local requirements as well. EVSE will need to comply with an AHJ’s building and electrical code requirements as a condition for receiving a permit.

As noted in the section “Beware of Soft Costs,” permitting can cause project delays and unforeseen costs that can be problematic for site hosts. Some jurisdictions have implemented expedited review processes and requirements for EVSE permitting to help address these issues, particularly in California, which requires localities to implement such processes. Some AHJs have developed guidelines, checklists, websites, and other information to assist site hosts.²³ Others allow application packages to be submitted online.

²³ The city of Tustin, California, has a checklist that exemplifies what an AHJ may require and what a checklist looks like. See: City of Tustin, “Eligibility Checklist for Expedited Electric Vehicle Charging Station Permit: Non-Residential Buildings and Facilities,” August 2017, <https://www.tustincta.org/DocumentCenter/View/647/EVCharger-Eligibility-Checklist--Non-Residential-PDF>.



KEY QUESTIONS

- What codes and ordinances apply to the site, construction, and electrical installation?
- Who is in charge of permitting at the AHJ? What permitting requirements are in place and what is the permitting timeline and process?
- Does the AHJ have an expedited permitting process?
- Does the local AHJ require a site installation plan? What else is needed in the application submission package?
- What local zoning, building code, or parking requirements need to be incorporated into the planning process?
- What are the requirements governing the operation of EVSE?
- What are the state or local requirements governing the operation of EVSE?
- What kind of software should the EVSE use at a charging site?



Common information the AHJ may need in the permitting process includes:

- Site plans (noted above)
- A single-line electrical diagram
- Load calculations and whether a panel upgrade will be required
- A separate mechanical permit application if ventilation will be required for the station
- Charger installation instructions from the manufacturer
- How the site host will address accessibility, with clear diagrams and text showing how the project will meet ADA requirements²⁴
- Easement requests, if necessary

Site hosts may work with contractors who interface with the AHJ and utility, prepare and shepherd the site plan and permitting package through AHJ approval, install or oversee the installation of the EVSE, and then request final inspections and approvals needed before the charging station

commences operation. Some AHJs may require special licensing of EVSE installers and contractors. Station developers must pay permit application fees when they submit a project, which are generally based on a combination of the percentage of anticipated cost of materials and construction, staff time, the size and scope of the project, any additional permits required, and fees for inspection.

Once the applicable permits are issued, construction can begin. The site may be visited by a building inspector one or more times during the process, including after construction is finished for final approval. After final approval from the AHJ and utility, the station is eligible for commissioning and operation.

Some localities have additional requirements in place, such as requiring a certain percentage of parking spots be dedicated to EV charging or requiring newly built facilities to include EV-capable infrastructure (even if a station will not immediately be built). States such as California are beginning to require local inspections of EVSE to ensure that the amount of electricity dispensed is accurate. The site host will need to meet these requirements.

²⁴ California Governor's Office of Business and Economic Development, *Electric Vehicle Charging Station Permitting Guidebook*, 28–29.

COMMON ISSUES IN THE PERMITTING PROCESS

Common errors that can arise in the permitting process include: inaccurate load calculations, inconsistent diagrams, and failure to comply with ADA accessibility regulations (such as inclusion of grades that are too steep, inaccessible placement of the charging station itself, and lack of accessible route and path of travel).²⁵ Some station developers who work with many contractors will have one team of contractors develop the plans and go through the permitting process but a different team of contractors install the charging station. While this can work if executed carefully, it raises the risk of mistakes in the construction process and inconsistencies with the approved permit, raising costs for both parties and causing frustration for inspectors and building officials. This is especially likely to happen if the construction and installation contractors have not seen the site before construction begins. Finally, adjacent local AHJs in a single metropolitan area may have different permitting requirements and other regulations governing EV charging, and site hosts will need to plan for that potentiality.

Even in a state like California, which has heavily supported the expansion of charging infrastructure, challenges with permitting remain, even with legislation that requires cities to implement streamlined and expedited permitting. As Electrify America noted in an August 2020 report to the California Air Resources Board, the average time to complete the permitting process for DCFC sites in California was 77 business days – nearly 60% longer than the national average.²⁶ Permitting processes also resulted in station sites being redesigned 33% more frequently in California than in the rest of the country. In fact, it costs Electrify America 28% more, on average, to design and construct a station in

California than it costs Electrify America to build a station with the same number of chargers in another state. Electrify America has noted that permitting burdens are the primary cause of this difference. This issue exists despite statewide streamlined and expedited permitting requirements, which only 19% of localities have implemented as of August 2020.

POTENTIAL ELEMENTS TO ADDRESS IN A SITE PLAN

Depending upon permitting and other requirements within an AHJ, a site plan may need to address the following elements:

- Utility interconnection requirements and an electrical plan
- Grading and drainage that may be required at the site
- Landscaping plan, particularly if any trees will need to be removed, which may trigger a tree removal permit
- Lighting
- Parking, with the number of required and existing parking spaces shown in the plan
 - Some AHJs are enacting ordinances that require a certain percentage of parking spaces be dedicated to EV charging
- Accessibility and compliance with ADA requirements
- Equipment anchorage
- EVSE protection, such as with the placement of bollards and curbs
- Ensuring right-of-way for pedestrians and ensuring that cords will not present trip hazards
- Types of station and wayfinding signage used to direct drivers into EV charging spaces

²⁵ California Governor's Office of Business and Economic Development, *Electric Vehicle Charging Station Permitting Guidebook*, 28–29.

²⁶ Electrify America, *Q2 2020 Report to California Air Resources Board*, August 17, 2020, <https://newspress-electrifyamerica.s3.amazonaws.com/documents%2Foriginal%2F502-Q22020ElectrifyAmericaReporttoCARBPublic.pdf>.

Some AHJs have specific requirements for signage, and any signs posted in a public right-of-way must be supported by local ordinances that specify time limits, penalties, and definitions. Any signs posted in the public right-of-way must meet requirements specified in the Manual on Uniform Traffic Control Devices (MUTCD).

TYPES OF SIGNAGE

The Federal Highway Administration (FHWA) defines the minimum standards for signage, which it publishes in the MUTCD, updated every five to six years.²⁷ The standards in the MUTCD apply to all signage on public highways, streets, bikeways, and private roads open to the public, such as at shopping centers and airports. State and local transportation departments may create and add custom signage, but they must meet the minimum requirements defined in the MUTCD to help drivers recognize signs from one jurisdiction to the next. [Figure 3](#) illustrates examples of FHWA-approved interim designs for charging station signs in the MUTCD.

FIGURE 3: SIGNAGE EXAMPLES

WAYFINDING SIGNAGE



STATION SIGNAGE



²⁷ “Signage for Plug-In Electric Vehicle Charging Stations,” Alternative Fuels Data Center, U.S. Department of Energy, https://afdc.energy.gov/fuels/electricity_charging_station_signage.html, citing Jeffrey A. Lindley, “Regulatory Signs for Electric Vehicle Charging and Parking Facilities,” memorandum, Federal Highway Administration, U.S. Department of Transportation, June 17, 2013, <https://mutcd.fhwa.dot.gov/resources/policy/rsevcpfmemo/>.



COMPLYING WITH ADA REQUIREMENTS

The ADA requires site hosts to provide accessible parking spaces at EV charging stations. When planning the layout of a charging station, adequate space must be provided for exiting and entering the vehicle, unobstructed access to the charger, free movement around the charger and connection point on the vehicle, and clear paths and close proximity to building entrances. [Table 5](#) summarizes ADA requirements as they pertain to EV charging.²⁸ Some AHJs may have additional requirements.



TABLE 5: SUMMARY OF ADA REQUIREMENTS PERTAINING TO EV CHARGING

ELEMENT	SUMMARY OF ADA REQUIREMENT
Number of spaces	4% of parking spaces, or one for every 25 spaces, in any given lot, be designated as accessible; one of every six spaces should be van accessible
Parking stall	8 ft. x 18 ft. for a car and 11 ft. x 18 ft. for a van
Accessible route width	Minimum 36 in.
Accessible route slope/cross slope	Maximum 1:20 (5%) running slope and 1:48 (2%) cross slope; accessible vehicle spaces 1:48 (2%) in all directions and 90 in. clearance for vans
Reach range	48 in. front and side to allow reach to all operable parts from a wheelchair
Accessible controls	Operable with one hand and not requiring grasping, pinching, or twisting of the wrist or force of more than 5 lbs. (exception: gas pumps)
Accessible ramps	A ramp or curb-cut must be accessible in order to allow for operation of charging station
Facility accessibility	Must be connected by an accessible route with a minimum width of 50 in. in proximity (not necessarily adjacent) to the entrance of the building
Side access aisle	Side access aisle of 60 in. wide to allow space for wheelchair and equipment in and out of space
Accessible card-reading devices	Must be connected by an accessible route with a minimum width of 50 in. in proximity (not necessarily adjacent) to the entrance of the building
Other considerations	Ensure that bollards, wheel stops, or curb do not obstruct use of charging station

Source: Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

28 Adapted from Iowa Clean Cities Coalition, *Electric Vehicle Public Charging Station Host's Handbook* (Des Moines, IA: Iowa Economic Development Authority), <https://www.iowaeconomicdevelopment.com/userdocs/programs/ev-infrastructureguide2019.pdf>. See also: Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines, 69 Fed. Reg. 44083 (September 21, 2004), 44083-44455, available at <https://www.federalregister.gov/documents/2004/07/23/04-16025/americans-with-disabilities-act-ada-accessibility-guidelines-for-buildings-and-facilities>.



OPERATION CONSIDERATIONS

Some states have set requirements in place governing the operation of EVSE, generally requiring multiple payment options for a charging session and/or prohibiting subscription fees. For example, California has set regulations enforced by the California Air Resources Board that include the following requirements:

- EVSPs must operate credit card readers and mobile payment device options on Level 2 and DCFC EVSE allowing payment by members and non-members at EVSE locations that require payment.
- The credit card reader device must accept, at a minimum, the Euro MasterCard Visa chip and, at a minimum, one of the following credit card types: Visa, MasterCard, or American Express.
- The EVSP shall provide and display a toll-free number on each EVSE or kiosk used to service that EVSE that provides the user with the option to initiate a charging session and submit payment at any time that the EVSE is operational and publicly available.
- EVSE must have a sticker informing drivers of voltage and amperage capabilities of the unit.
- All fees associated with a charging session must be posted. The fees may include, but are not limited to, the kWh or megajoule (MJ) cost of electricity, credit card fees, parking fees, non-membership plug-in fees, increased charges after plug-in session ends, and any other fees chargeable to the PEV user. Fees must be displayed at the point of sale to ensure the fee structure is transparent to the driver. Consumers paying for a charging session must be billed for electricity by \$/kWh or \$/MJ.²⁹

Local AHJs may set other requirements that relate to operation as well.

²⁹ "Electric Vehicle Supply Equipment (EVSE) Standards," California Air Resource Board, <https://ww2.arb.ca.gov/our-work/programs/electric-vehicle-supply-equipment-evse-standards>, citing Attachment A: Final Regulation Order, June 2020, https://ww2.arb.ca.gov/sites/default/files/2020-06/evse_fro_ac.pdf. This regulation implements AB454, Chapter 418, Statutes of 2013, http://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=201320140SB454 (see also California Health and Safety Code 44268 and 44268.2).

EVSE SOFTWARE

Different EVSE models have different levels of technological capabilities. Basic software, also known as “dumb” or non-networked chargers, communicate with only the vehicle once it begins the charging session and ends the charging session.³⁰ Reporting and fee collection capabilities are very minimal for basic chargers, and they typically work best when the EVSE is connected to a separate electrical meter or assigned to a specific person so that payment can be allocated correctly.

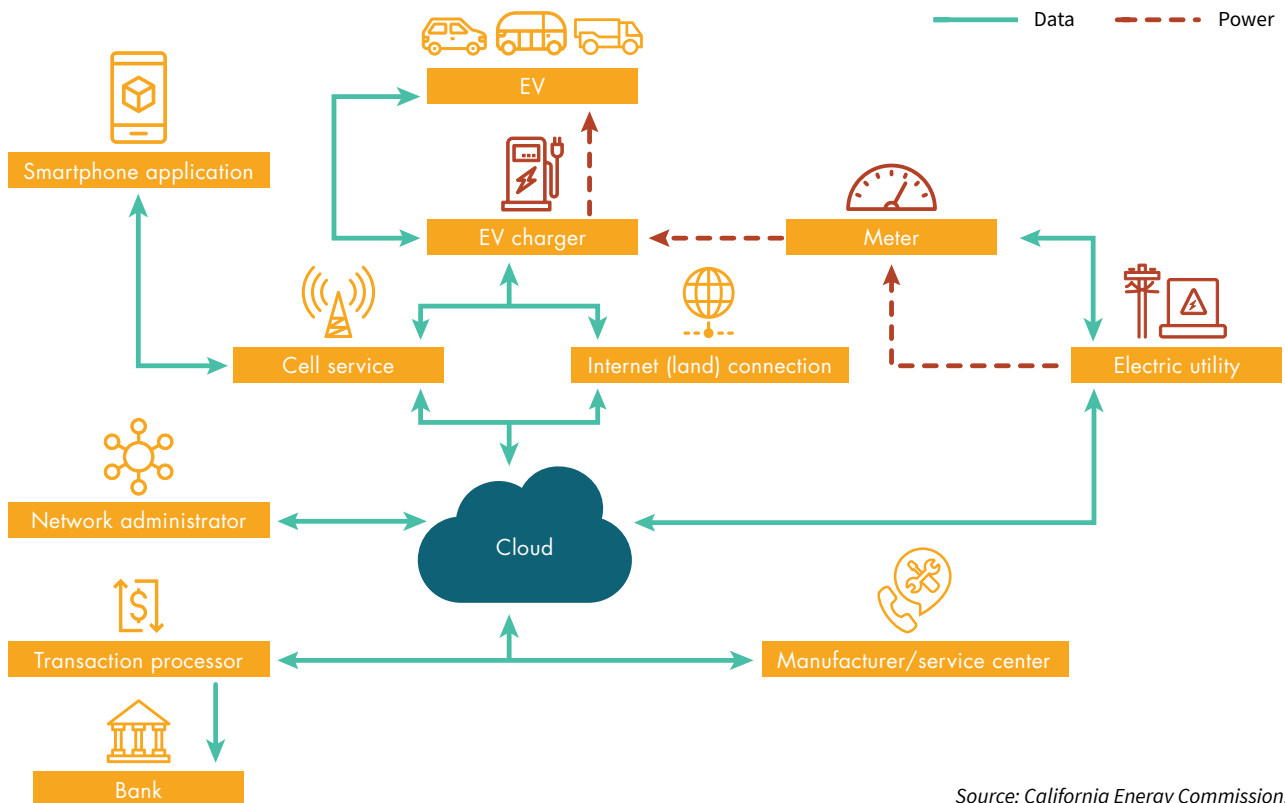
“Smart” chargers connect by cellular, Ethernet, or Wi-Fi, and their capabilities make the upfront cost more expensive as they may require an ongoing monthly, per session, or annual networking fee to the user, site host, or both. However, the levels of communication are much greater because they can

communicate with the site host, utility grid, internet, and user. Smart chargers can mitigate issues that may arise, such as monitoring and setting limits on a station’s energy consumption and reducing demand charges from the utility. System alerts can ensure more available access to and use of EVSE charging spaces. [Figure 4](#) shows how a smart charger network operates.

Smart chargers can communicate between and connect to:

- An EV to parking space
- An EV to EVSE or EV charger (EVC)
- A user to payment network
- An EVSE to site host
- A user to vehicle

FIGURE 4: HOW NETWORKED SMART CHARGING FUNCTIONS



Source: California Energy Commission, 2018

30 City of Boston, *How-To Guide: Electric Vehicle Charger Installation*, June 2020, <https://www.boston.gov/sites/default/files/file/2020/06/How%20To%20Install%20an%20EVSE%20.pdf>.

The information to the user can be provided by smartphone, radio frequency identification (RFID) tag, or computer and can include a high degree of information. Many smart chargers use an application on a smartphone, though there is no common platform for EV charging at this time. [Table 6](#) summarizes smart charger technology and how it functions for the site host and user.

Smart chargers generally employ two types of service networks:

- **Subscription-only access:** Users subscribe to the service network, which typically requires an initial deposit and periodic deposits to keep a payment account active. Users then connect their vehicles and use a dedicated RFID card or smart phone app to initiate a charging session and complete an electronic payment transaction.

These services may include a subscription fee, charging session fees, incremental fee based on the amount of electricity consumed, or some fee combination.

- **Open access:** These service networks provide a dedicated subscription but also accept universal payment methods such as credit cards. Some states, such as California, require that all public charging stations must be open access.



TABLE 6: SUMMARY OF SMART CHARGER TECHNOLOGY

TECHNOLOGY	FUNCTION FOR SITE HOST	FUNCTION FOR USER
Advanced payment collection options	Little management and oversight required for payment system	Enables easy payment for fee collection
RFID/NFC communication		Enables easy access control by issuing special key fobs
Network and telematics capability	<ul style="list-style-type: none"> • Supports rate determination • Reporting includes user identity and energy consumption • Communicates in-use status • Helps troubleshoot issues • Enforcement regulations • Offers alternative for parking regulations by charging a fee for time spent parked • Allows customized fee over time, energy, or session • Includes remote software upgrades and service 	<ul style="list-style-type: none"> • Enables data collection • Demands response interaction with the grid • Communicates charging station availability and reservation capability • Communicates rate of charging • Displays fee rates • Notifies session completion • Reports fee totals, electricity used, date, location, and time spent charging
Touch screens/video capabilities	<ul style="list-style-type: none"> • Advertisement opportunities, internal or external • Branding opportunity 	<ul style="list-style-type: none"> • Easy to use • Interface for clear display of information

Source: City of Boston, How-To Guide: Electric Vehicle Charger Installation, June 2020

“Plug-and-charge” is being rolled out in new EV models, such as in the 2021 Ford Mustang Mach-E.³¹ Similar to the system Tesla has already been operating for its EVs and charging network, plug-and-charge allows a driver to automatically charge at a station and be billed for the charge session. Each vehicle is linked to an individual billing account, whether personal, family, corporate, or other EV owner.³² Authentication standards allow the EV to automatically identify itself to the charging network and have the backend system issue validation and then begin the charge. The transaction will be accurately documented to reflect the energy that was supplied to the EV. It streamlines and simplifies the charging process for EV drivers. Right now, drivers may need to have subscriptions to access charging networks and/or they may need to use a credit card, present an RFID tag, and use a mobile app to use them.

ChargePoint and EVgo in 2019 concluded a roaming agreement that will enable EV drivers to roam between their charging networks while traveling throughout the U.S.³³ The agreement eliminated the need for drivers to register for multiple accounts and ensures they do not incur additional fees when roaming. It made more than 30,000 places to charge accessible to drivers on either network. The roaming agreement was developed based on the Open Charge Point Interface protocol, an independent, open protocol that enables network operators to exchange key information needed to provide roaming services, which gives EV drivers a number of benefits. (Electrify America also supports the Open Charge Point Interface protocol.)

31 John Voelcker, “Plug and Charge Brings Tesla-Style EV Charging Simplicity to Other Brands,” *Car and Driver*, Dec. 25, 2020, <https://www.caranddriver.com/news/a35044132/plug-and-charge-ev-charging-mustang-mach-e/>.

32 “What is Electric Vehicle Plug & Charge?,” *Driivz*, March 4, 2021, <https://driivz.com/glossary/plug-and-charge/>.

33 ChargePoint, “ChargePoint and EVgo Announce Roaming Agreement, Expanding Access to Charging Nationwide,” press release, June 18, 2019, <https://www.chargepoint.com/about/news/chargepoint-and-evgo-announce-roaming-agreement-expanding-access-charging-nationwide/>.





CASE STUDIES

SHEETZ PARTNERS WITH TESLA

After testing DCFC at five of its sites, Sheetz in 2017 opted to work with Tesla (as well as EVgo and Electrify America) to install, operate, and maintain Supercharging stations.³⁴ As of April 2021, Tesla and Sheetz have deployed Tesla Superchargers at 44 Sheetz locations. Mike Lorenz, former executive vice president of petroleum supply at Sheetz, noted the collaboration has worked well for both companies. Tesla can serve its driver population by locating Superchargers where drivers need them and in places with key amenities that Tesla drivers need, such as food, beverages, ATMs, restrooms, and Wi-Fi. Sheetz found the station development, operation, and maintenance processes challenging when it initially developed its first sites on its own in 2013 but was able to cede those responsibilities to Tesla, which had considerable experience in these areas and preferred to oversee that process. “Tesla is a first-class operation to deal with, very professional and thorough,” Lorenz said. Sheetz gains customers for its stores and has been able to build relationships with them. “Our top locations are doing over 60 charges per day with dwell times of around 20 minutes on average. Having Superchargers makes

your facility a destination for Tesla drivers to seek out and plan a trip around,” Lorenz said.

TESLA’S BEST PRACTICES

Tesla owns and operates more than 24,000 DCFC chargers in its global Supercharger network, the largest in the world, and has developed strong relationships with a range of different parties, including those in the convenience store and fuel retailing industries. What are Tesla’s best practices as it continues to expand its network and develop partnerships?

- **Customer-centric:** It’s important that on-property amenities reflect the region and the customer’s dwell time, which is about 25 minutes or less. Convenience stores, as an example, are a natural fit with an expanded range of food and beverage items, ATMs, bathrooms, Wi-Fi, and 24/7 availability. The EV driving community is growing quickly, ensuring the stations and capacity that they need is a top priority. Properties should consider at least 12 Tesla charging stalls and the expectation of deploying within six months. The network should roughly double every 12 months to keep pace with Tesla fleet growth.

³⁴ Samantha Oller, “Sheetz Puts EV Charging to the Test,” CSP, Winsight, November 17, 2017, <https://www.cspdailynews.com/fuels/sheetz-puts-ev-charging-test>.

- Thoughtful design:** Customers are looking for a convenient, intuitive, and quick charging experience, and achieving this requires a thoughtful approach to design. Ensuring the station both has sufficient capacity for the growing EV driver base and is tailored to the on-property experience is critical. Stations should consider at least 12 charging stalls where possible and have easy access to major commuting and travel corridors. On property, safety and access to the storefront are key. Although charging stalls do not need to be located at store entrances, convenience, traffic flow, and customer safety should drive the station’s location. The design should also consider proximity to critical site infrastructure such as sufficient lighting and access to power. Integrating EV charging projects into the new convenience store development process is a great opportunity to pursue customer experience improvements, such as expanded seating areas, and more efficient station designs, such as a shared utility equipment footprint.
- Streamlined development process:** A clear and streamlined process is necessary for any charging program to be successful and achieve the scale that customers demand. Given the fast pace of convenience store development, defining this upfront is necessary to minimize project disruption and maximize deployment productivity. This is especially important when incorporating EV charging infrastructure into new convenience store construction, which offers both significant cost and real estate footprint efficiencies.



EVGO PARTNERS WITH THE SAVE MART COMPANIES TO DEVELOP EV CHARGING AT ITS STORES

As the largest family-owned grocer in California, operating 204 stores across California and northern Nevada, The Save Mart Companies is invested in the success of its communities. Save Mart, Lucky, Lucky California, and FoodMaxx stores don’t just serve the community; they are a vital part of the communities they serve and have long been committed to environmental best practices.

Fast charging project highlights:

22 EVgo charging locations

66,558 Annual EVgo fast charging sessions

1,759,269 Annual charging minutes

1,068 Pounds CO2 avoided

2,647,676 Zero-emission miles

The Save Mart Companies began partnering with EVgo in 2015, installing their first electric charging station at the Lucky store in Fremont, California. This station was the largest publicly available fast-charging site with different charging plugs to accommodate a range of EVs in the U.S. at the time. The company has continued its commitment to the environment by since installing 31 additional fast chargers and two L2 chargers.

The Save Mart Companies customers charged over 1.7 million minutes in over 66,500 sessions in 2019 alone, each session powered by EVgo’s 100% renewable energy commitment. Those 2019 charging sessions added up to more than 2.6 million zero-emission miles, avoiding over 1,000 pounds of CO2 emissions.

Today, The Save Mart Companies offers EV charging stations at 22 stores, providing their customers with a fast and convenient way to charge their EVs while they shop. EV charging is one of the ways The Save Mart Companies demonstrates that its sustainability pledge and commitment to its communities are critical to their core values.

“Many drivers in California and Nevada are transitioning to EVs. By providing EV charging stations at our stores, The Save Mart Companies is helping to forge the path towards a greener future,” says Hal Levitt, senior vice president of retail operations for The Save Mart Companies.

WALMART AND ELECTRIFY AMERICA PARTNER TO DEVELOP DCFC ACROSS THE U.S.

Walmart and Electrify America partnered to develop a 120-DCFC charging station network, which was completed in June 2020.³⁵ The network, located in 34 states, will give EV users increased access to charging near highways, rural communities, and driving routes in underdeveloped and underserved parts the country. EV charging station placement along many of these routes give EV drivers the option to solely recharge at Walmart stores during their travels (Figure 5). Examples of routes include:

- **Houston to Chicago** via I-45, I-35, and I-44
- **San Antonio to St. Louis** via I-35 and I-44
- **Washington, DC, to Savannah, Georgia**, via I-95

FIGURE 5: ELECTRIFY AMERICA CHARGING STATIONS AT WALMART STORES



Source: Walmart, 2019

35 Walmart, “Electrify America, Walmart Announce Completion of Over 120 Charging Stations at Walmart Stores Nationwide with Plans for Further Expansion,” press release, June 6, 2019, <https://corporate.walmart.com/newsroom/2019/06/06/electrify-america-walmart-announce-completion-of-over-120-charging-stations-at-walmart-stores-nationwide-with-plans-for-further-expansion>.

FUEL RETAILERS CAN OFFER CHARGING AND SELL LIQUID FUELS, TOO

Looking at Tesla’s Supercharger network growth in the convenience space, it’s evident that fuel retailers can be successful selling liquid fuels while offering charging. What’s critical is the customer experience. With the growing importance of retail, food, and beverage to the convenience store industry along with greater availability of EV models, convenience stores must welcome more EV drivers.

The experience of fuel retailers and convenience stores working with Tesla has shown that operators can grow their customer base when they offer charging as an amenity. Offering charging services is a great way to attract new customers while retaining existing customers that have converted to EVs. Due to charging session lengths, EV drivers can help grow and solidify high-margin food and beverage sales. With a typical dwell time of about 20 minutes, EV customers offer a unique engagement opportunity for a broader set of goods and services. The retailer’s experience with Tesla has shown EV drivers are recurring customers, often planning their weekly schedules and long-distance travel schedules around charging infrastructure.

The Tesla Supercharger experience at convenience stores has shown that providing charging services is a great opportunity to introduce new products and innovative sales channels. These products and services do not have to be limited to food and beverage concessions items. As the retail landscape evolves with a focus on digital channels and convenient last-mile solutions, convenience stores are well positioned to play a critical role in the end state. Combining this with EV customers’ demographic and engagement profiles makes convenience stores and charging infrastructure a natural pairing.

IT’S ALL ABOUT BUILDING AND LEVERAGING RELATIONSHIPS FOR KUM & GO

Kum & Go operates 400 stores in 11 states and is based in Des Moines, Iowa. The company offers EV charging at a number of its sites, having both installed and operated its own charging stations as well as partnering with third-party charging companies including Tesla and ChargePoint. What was the company’s process for determining whether to offer charging space? Brad Petersen, director of retail fuels at Kum & Go, says that the very first question the company evaluated is how they saw the future of their organization and whether EV charging fit. The company also looked at overall market trends and, notes Petersen, “We took a deep dive and learned all that we could about EVs and EV charging. That’s when we decided as an organization that we would begin offering EV charging at our sites. We created a plan. That’s important — you have to have a plan.”

The company also capitalized on experts already in its organization to work on expanding EV charging. For example, the company has a dedicated energy manager who is specifically responsible for overseeing all power charges for utility connections for sites. The energy manager is not only an expert on utility-related issues but has existing relationships at utilities that Kum & Go was able to leverage in developing EV charging sites. Thanks to an existing relationship, MidAmerican Energy directly offered Kum & Go a grant to develop EV charging sites that was 100% funded by the utility.

The company also has a sustainability manager and a dedicated point person who works on EV charging. These staff members and others, such as the company’s construction real estate development managers, meet once a month specifically on EV charging issues. The company also meets regularly with its third-party charging partners. “We learn so much from them. Developing these relationships

is critical,” Petersen says. Petersen adds that leveraging relationships with utilities, third-party EV charging companies, and others is also critical to finding out about funding opportunities for public EV charging, even though its EV manager also monitors funding opportunities for the company. “That’s the other hard part is knowing where to find these funds. That’s probably your next step: Who finds these grants? Where do you find them? How do you get to know about them? How do you apply? That alone is a whole process.”

YES, YOU CAN BE AN EV CHARGING OWNER-OPERATOR

Jim Burness is CEO of National Car Charging, a firm that sells EV charging equipment, along with station management and consulting services, to a range of customers in the EV charging space, including public charging customers. The firm has placed over 5,000 commercial charging stations across the country, working on projects large and small. They will also assist customers, if necessary, by leveraging the company’s network of licensed, certified professionals across the U.S. to ensure stations are installed to code and meet the customer’s specifications.

Burness says that being an owner-operator of an EV charging site is not as difficult as it may seem: “It’s not rocket science. My thought is, ‘Others clearly see it as a business opportunity, so why not do it yourself?’ You retain control and it is easier than managing a gas pump, and I don’t really know any gas stations that let a third party come in and operate their gas pumps for \$7 a gallon.”

Burness adds, “We provide a warranty and a complete service plan. We will hold your hand through the process if need be. There are providers out there like us who will take care of you and will make sure that this is as easy as possible and get you where you need to be with a minimum amount of pain.”

Burness points out that there is money to be made in charging, especially as the EV market continues to scale up in the U.S., so why shouldn’t it be the site host who is making the money? He notes that incentive funding can make the ROI even more attractive to prospective site hosts. Another important issue Burness asks prospective clients is who owns the environmental attributes? For example, under the California Low Carbon Fuels Standard program, credits for electricity provided to EVs can be generated, claimed, and sold under the program. In many cases, third-party charging companies will generally own the attributes or credits, but an owner-operator site host could claim those credits themselves to generate further ROI.

And what about dealing with demand charges? “Our message to utilities is, ‘Look, you can either do demand charge reform, or somebody’s going to put storage in and take that revenue source away from you. Your choice. What are you going to do?’ That usually wakes them up pretty quickly,” Burness says. “So now we’re seeing programs like the demand charge holiday in southern California.” But there are other ways to deal with demand charges, according to Burness: “The first one is very simple. If there are enough cars on the road to make it a problem, we can detune the hardware a little bit. My local utility, for example, hits users with a demand charge at 50 kW, so we would set up a DCFC to max out at 45 kW to avoid the charge. We are also, along with many others, working on storage solutions that can be put behind the DCFC to help avoid demand charges.”

HOW DOES ELECTRIFY AMERICA EVALUATE POTENTIAL SITES?

For its Cycle 2 investment plan, Electrify America began with a list of the 60 largest U.S. cities, analyzed BEV sales in early 2019 and forecasted for 2022, and then narrowed the list to 40 cities. These cities were then evaluated on four key metrics: their expected needs for charging infrastructure (the supply-demand gap), local electric utility costs and

“[Being an owner-operator] is not rocket science. My thought is, ‘Others clearly see it as a business opportunity, so why not do it yourself?’ You retain control and it is easier than managing a gas pump, and I don’t really know any gas stations that let a third party come in and operate their gas pumps for \$7 a gallon.”

JIM BURNESSE, CEO OF NATIONAL CAR CHARGING
EV CHARGING EQUIPMENT, STATION MANAGEMENT
AND CONSULTING SERVICES

collaboration opportunities (utility environment), state and local policies impacting EV adoption (policy environment), and the fit of the metro area with Electrify America’s broader network (proximity to the Electrify America network). From that analysis, 18 metropolitan areas were selected for metro community charging investments in the Cycle 2 plan. Electrify America explains its process in the plan:³⁶

- **Supply-demand gap:** “The projected gap in supply and demand for BEV charging was determined by: (1) calculating the projected charging power demand (in [megawatt hours per day] MWh/day) for public charging in 2022 outside the home; and (2) subtracting the current supply of power delivered by public charging for each metropolitan area. Demand for public charging in a metropolitan area was calculated using the projected number of BEVs in operation by 2022, the average daily vehicle miles traveled as collected by the Federal Highway Administration, the mix of single-family and multiunit homes from the U.S. Census Bureau, and assumptions for vehicle efficiency and the portion of charging occurring at homes. Supply of charging power was estimated using existing charging infrastructure in Recargo’s PlugShare database with assumptions made regarding the power level and utilization at each station. Electrify America stations currently under development as part of Cycle 1 were added to the charging supply calculations in each metro to provide a more complete picture of future supply.”
- **Utility environment:** “An EV-focused utility environment, with utility infrastructure support (such as make-readies), DCFC specific energy rates, and lower or non-existent demand charges, can have a significant impact on the economics of the station. In addition, streamlined utility processes can accelerate site construction and

dramatically lower both capital and operating costs. Metro areas where these same conditions are not as positive, especially those with high demand peak charges, can make the economics of owning and operating DCFC stations over the long-term particularly challenging. This metric evaluates both the utility costs to operate DCFC stations within a utility territory, as well as the collaboration potential of the local utility.”

- **Policy environment:** “Electrify America commissioned the National Association of State Energy Officials, in partnership with The Cadmus Group LLC, to develop the Plug-In Electric Vehicle Policy Tool to evaluate the impact of state and local policies on [PEV] adoption in states and cities across the United States.³⁷ The Tool was designed for Electrify America to use when considering potential metro areas for Cycle 2 investment and allows the user to evaluate the combined strengths and weaknesses of all PEV-related policies in a given metro area on a scale of 1-100 and compare the result with other metro areas.”
- **Proximity to the Electrify America environment:** “When considering the purchase of a new vehicle, many buyers look not only at the fueling options within their own metro area, but also on key routes to nearby regional destinations.... Therefore, it is important that Electrify America support not only the local charging needs, but also charging within a reasonable driving radius from home. This metric reflects how many Electrify America highway stations are located within a 120 mi. radius of the metropolitan area’s borders.”

³⁶ Electrify America, *National ZEV Investment Plan: Cycle 2*, February, 4, 2019, <https://www.electrifyamerica.com/assets/pdf/Cycle%202%20National%20ZEV%20Investment%20Plan%20-%20Public%20Version%20vF.50bb1fe0.pdf>.

³⁷ The interactive Plug-In Electric Vehicle Policy Tool is publicly available at https://naseo.org/Data/Sites/1/pev-policy-evaluation-rubric_final.xlsx.

CUSTOMER CARE IS A CRITICAL PART OF EVGO'S OFFER

EVgo owns and operates the largest public fast charging network for EVs in the U.S. as of May 2021. The company owns and operates more than 800 fast charging locations and more than 1,000 Level 2 charging locations in 67 metropolitan areas serving more than 220,000 customers. Most of its stations have DCFC 50 kW chargers, and it opened its first 350 kW station in 2018. The company builds and installs all its own charging stations and works with local jurisdictions on permitting for the site. When assessing potential sites, EVgo considers a number of factors, including:

- Amenities at the site for the customer convenience, such as Wi-Fi, food, restrooms, and whether the site is close to other retail establishments
- Proximity to major thoroughfares
- Visibility from the road
- Easy ingress and egress
- Proximity to the transformer and other electrical equipment, if possible
- Overall safety at the site for the customer

EVgo uses [EJSCREEN, the U.S. Environmental Protection Agency's environmental justice screening and mapping tool](http://epa.gov/ejscreen) (<http://epa.gov/ejscreen>), in its mapping to ensure the company is reaching a broad range of communities.

EVgo works with the site host to determine the optimal placement of the chargers at the site. The company also works with and establishes agreements with local utilities to provide secure electricity for the site, monitors and maintains the equipment post installation, and provides marketing support to increase spend at retail sites as well as driver and host support.

It is this last point — support — that EVgo says can be a major selling point for site hosts. “That’s our everything,” said Marcy Bauer, senior vice president of program delivery at EVgo. “We have standard levels of service that we obligate ourselves to and it applies to every part of our supply and service chain.” Bauer notes that part of the turn-key partnership that EVgo offers is a 24/7/365 customer call center that is dedicated, fully trained, and only works for EVgo. Call center staff members are trained and empowered to do certain technical resets on their own before it goes to EVgo’s customer field operations team.

A tiered organization manages customer issues for EVgo. Call center staff members can do diagnostics on their own to assist customers in resolving charging issues. EVgo has found that many times there is a mix of operator and system error that the call center has experience in resolving. If simple diagnostics can’t resolve the customer issue, although most often it does, call center staff will find another charging point, no matter which company it belongs to, to get the customer charging.

“There are all kinds of customer care and satisfaction metrics we have in place. The better we do in meeting those, the more that builds the brand both for EVgo and the partner,” Bauer notes. “EVgo regularly scores high on our Net Promoter Score and receives high scores on PlugShare, which tracks customer experience at stations. The partner doesn’t have to touch it or deal with customer issues in any way. We also do the same thing for the site host as well, supporting them with our customer care and account management teams. All they have to do is keep the parking spaces clear — that’s it. It’s a pure amenity for the site host.”



UNDERSTAND YOUR USER NEEDS AND MAKE A PLAN FOR STATION MANAGEMENT

Dallas-Fort Worth International Airport (DFW) owns and operates over 30 L2 charging stations for EVs and plans to install more as EV uptake continues to increase across the region. Airport program managers also plan to add DCFC stations at select on-site locations. DFW has utilized data from the North Central Texas Council of Governments to understand regional EV market growth and inform its decisions on EVSE deployment.

Airport staff has installed EVSE from a range of vendors over time and understanding user needs is important when selecting a charging station level and model, according to Zoe Bolack, an environmental analyst in the Environmental Affairs Department at DFW. DFW offers charging for the public and employees and is currently installing charging stations for its first electric fleet vehicles. Different models are best suited for various applications, and features like access control

and waitlists make sense to integrate at some stations but not others. Furthermore, grant-funded stations often have reporting requirements, so DFW subscribes each station to a cloud plan as a standard practice.

Bolack says DFW has also found that it is advantageous to form a comprehensive plan for station management prior to charger installation and activation. An organization should determine who will be responsible for EVSE maintenance after the warranty period expires and whether it prefers to handle maintenance internally, through a contract with the vendor, or through a contract with a third-party maintenance provider. As its EVSE network expands, DFW is also exploring power management and battery storage opportunities to reduce demand charges from high electricity use during peak hours. To accomplish this, DFW has partnered with the National Renewable Energy Laboratory to develop an EV blueprint and strategize vehicle deployments and infrastructure investments for light-duty vehicles and heavy-duty buses.

WHAT DOES ELECTRIFY AMERICA LOOK FOR IN POTENTIAL PARTNERS?

Electrify America was established by Volkswagen in 2016 as part of a consent decree reached with the U.S. Department of Justice in the “Dieselgate” case. Over a 10-year period comprised of four 30-month cycles, the company plans to invest \$2 billion on EV infrastructure, access, and education programs in the U.S. Electrify America is currently in its second funding cycle that ends in 2021. For each funding cycle, it has solicited comments and suggestions from the public on where to build out infrastructure, and the company must also submit its plans to both the California Air Resources Board and the U.S. Environmental Protection Agency.

The first cycle of funding focused on building out a nationwide network of ultra-fast charging sites along the heaviest traveled highway routes in the U.S. as well as expanding EV charging infrastructure in 17 metro areas across the U.S. with higher levels of EV ownership. Cycle 2 funding focused on expanding EV charging infrastructure to another 18 metro areas as well as on major highways and regional routes in the U.S. The company is currently developing its third cycle plan.



As of February 2021, the company has established over 550 charging locations and 2,400 individual charging units across the country. These charging locations were designed to be future-proofed for upcoming generations of EVs, with chargers at a minimum of 150 kW and many sites capable of 350 kW of power. Electrify America has worked with many site host partners in developing EV infrastructure across the country, including major big box retailers, fueling station chains, large real estate investment trusts, and small mom-and-pop businesses.

Peter Thomas, commercial business development manager at Electrify America, notes that the company looks for several attributes in potential partners, including:

- Ownership and control of the real estate by the proposed site host
- Available space for charging hardware, including landscaping areas that can be utilized to minimize impact to parking count
- Availability of 480 volt (V) utility service adjacent to proposed charging site
- Site host willingness to execute an easement with the electrical utility
- Nearby retail and other customer amenities
- For highways, a maximum distance of two miles from an exit

With respect to parking, Thomas notes there are a lot of concerns about parking count, especially in California. For example, “if our site host is going to lose five parking spaces because of our equipment pad, that may raise red flags within their own organization. Say the site host has future plans to develop a different part of the property and they know they’re already going to lose parking spaces; that may either kill the project or result in a reduction in the number of chargers we can install. In other cases, the site is already at its minimum parking space count.”

The adjacency to utility on the site is critical as well. “That’s part of the overall due diligence that we do before we sign a lease. We go to the property in person and we locate the closest utility source that could supply power to the site. We then verify with the utility that the identified utility source will be viable for the project,” Thomas says. “We will also then be able to determine, based on the results of the land survey, whether the switch that is going to provide power to our chargers is located on the property of a third party. That would necessitate a third-party easement to build our site, which usually means the project is dead. So that upfront due diligence is absolutely critical to ensure you aren’t sinking capital into the design of a project that will either have very high upfront utility costs or one that is high-risk due to this requirement of a third-party easement.”

The adjacency to retail and other amenities is key to the customer experience at the site. “We receive some criticism because some of our site hosts are not traditional retailers (big box, grocery, etc.) or fueling stations, but if you actually visit those sites with non-traditional site hosts, you will find that they are always in areas where there’s plenty of places

nearby to grab some food, use the restroom, and do other things,” Thomas says. “Usually, they’re located in larger developments where you can easily walk to whatever you want to do.”

WHAT YOU NEED TO KNOW ABOUT UTILITY ENGAGEMENT FROM DUKE ENERGY

In addition to electrifying its own fleet and running its own employee workplace charging program, Duke Energy runs several EV public charging programs in Florida, North Carolina, and South Carolina. The company also has worked extensively with third-party charging companies and other hosts in developing public EV charging sites. What can prospective site hosts, especially owner-operator site hosts, learn from Duke Energy’s experience?

- 1) **Upfront utility engagement is critical:** Alvin Etheredge, an account executive at Duke Energy, says, “If you’re going to install a charging station, first consider where you are going to put it on your site. What is the least expensive way to get it operational from a capital side? This may seem obvious, but if a power line is on one side of your property and you want it underground, and the



charging station is on the other side, you may have to burrow underneath a lot of concrete. That’s going to affect the development cost.”

Peter King, electric transportation project manager at Duke Energy, agrees: “It’s one thing to say, ‘Here’s where I want to put chargers.’ It’s another to find the most cost-effective location.” Consulting a utility early is the best approach to help work through these issues and discuss what makes the most sense. Site hosts can also ask for a preliminary site evaluation from the utility as they assess options for the charging station (third-party charging companies will do this work with the utility as part of developing a site).

“Offering EV charging at shopping centers and grocery stores may present unique challenges,” Etheredge says. “A lot of times, the existing utility infrastructure is at the back of the building and not out front in the parking lot where you would want to have your charging. Planning with the utility is critical, as is understanding local zoning and other requirements, especially as they pertain to parking. If you’re going to take up parking spaces for equipment, like switchgear for example, is the city going to be okay with that if you’re tight on your parking numbers?”

2) Work with the utility closely to understand what the power needs for the site will be:

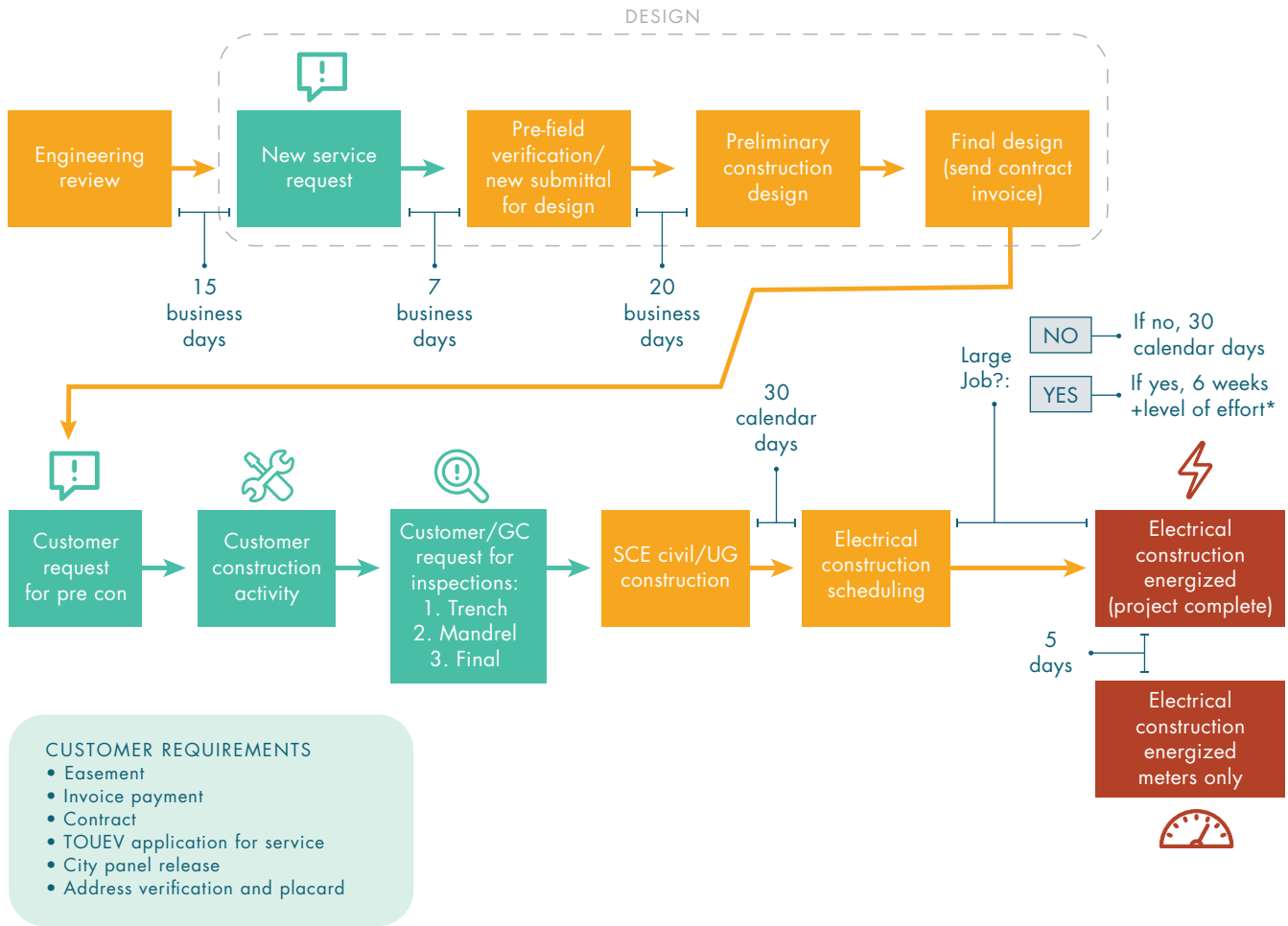
Etheredge and King say a site host should consider what their power needs will be for charging and whether what they have is enough. Etheredge notes transformer size is important, and the transformer must have the existing capacity to add charging. Voltage needs are also important to consider. For example, most fuel retailers probably have 122 three-phase voltage while most large DCFC need 480 to operate.

“It’s critical for site hosts to be aware of contribution of aid in construction fees that may arise,” King says. “If an upgrade to existing electric service is required where no connection currently exists, equipment will need to be added to the electric system. The utility may charge a contribution of aid in construction fee to do the work, and this can get overlooked.”

- 3) **Don’t skimp on power:** “If you’re going to build to the specs, build it to the specs where the EV charger is operating,” Etheredge says. “Don’t cut corners so much that you impact the performance of the site. For example, if a municipality installs Level 2 charging but skimps on the breaker size, the chargers won’t have enough power to operate.”
- 4) **Understand your rates:** “It’s really important for site hosts to understand what their rates will be and how their utility bill will change. It’s critical to understand each part of the bill, line item by line item,” King says.
- 5) **Understand that sites installed under public utility commission–approved programs may have constraints:** “Commission-directed grant programs have specific requirements that the utility must follow,” King says. The utility will play an important role in site selection and may allocate resources for developing sites. If the infrastructure requirements are complicated, it may impact the selection of a site.

“You can put a charging station out in the middle of a cornfield in the middle of Florida, but guess what? That’s going to cost you a lot of money to run power to them,” King says. “We try to come up with options. Every installation is a little different and customized because each site has its own needs.”

FIGURE 6: SCE TIMELINE AND PROCESS FOR COMMERCIAL CUSTOMER EV CHARGING INFRASTRUCTURE PROJECTS



Note: Please allow 48 hours for processing new submittals for design and construction scheduling. Large jobs are determined by labor hours it takes an SCE crew to complete a project. Small jobs are less than 120 man-hours; large jobs are greater than or equal to 120 man hours.

*Level of effort is the quantity of days needed to complete the SCE screw work.

Source: Southern California Edison, 2019

SOUTHERN CALIFORNIA EDISON'S EV OUTREACH

Some utilities, such as Southern California Edison (SCE), are developing information materials, websites, and even teams and/or specific company contacts tasked with assisting station developers throughout the design and construction process. SCE helps outline the development process, select

rate plans, and estimate charging needs and energy management capability for developers. It has a range of materials for different types of charging (for example, fleet, public, and workplace charging) on its website.³⁸ The company has also shared its process and timeline for utility interconnection and has developed a timeline for commercial EV charging station projects.³⁹

38 "Electric Vehicles for Business," Southern California Edison, <https://www.sce.com/tl/business/electric-cars>.

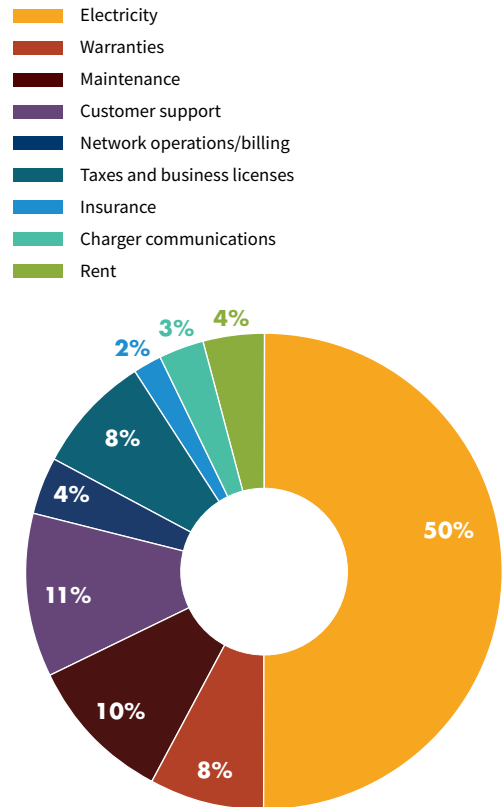
39 Bolduc et al., *Utility Best Practices for EV Infrastructure Deployment*, 45.

EVGO AND THE EFFECTIVE KWH PRICE FOR ELECTRICITY

EVgo noted in a May 2020 paper that electricity procurement makes up 50% of operation costs for DCFC.⁴⁰ The remaining costs are shown in [Figure 7](#).

The company cautions that consumers and stakeholders “vastly underestimate both the nameplate electricity rates for commercial EV charging and the ‘effective’ kWh price based on the real fees levied to a charging station by the utility.” The company further notes, “The effective price of electricity can vary greatly by utility territory and utilization. Commercial electric rates are usually comprised of a variety of fixed, volumetric, and peak demand-based rate components which may vary by season, day of the week, and time of day. Because fast charging equipment can draw peak demand for portions of an hour, for lower utilization chargers demand charges can significantly skew the nominal rate to an exorbitant effective rate. For example, an actual bill for an EVgo charger in [Pacific Gas and Electric (PG&E)] territory appears below in [Figure 8](#), where despite an ‘energy charge’ of 17.8¢ per kWh, the effective price to EVgo was \$1.61 per kWh.” Utilities and regulators in states are beginning to recognize this issue and design rate structures that encourage deployment of charging. In fact, with the encouragement of EVgo and others in the charging space, PG&E restructured its tariffs to recognize the beneficial electricity load from charging.

FIGURE 7: DCFC OPERATIONS COSTS



Source: EVgo, May 2020

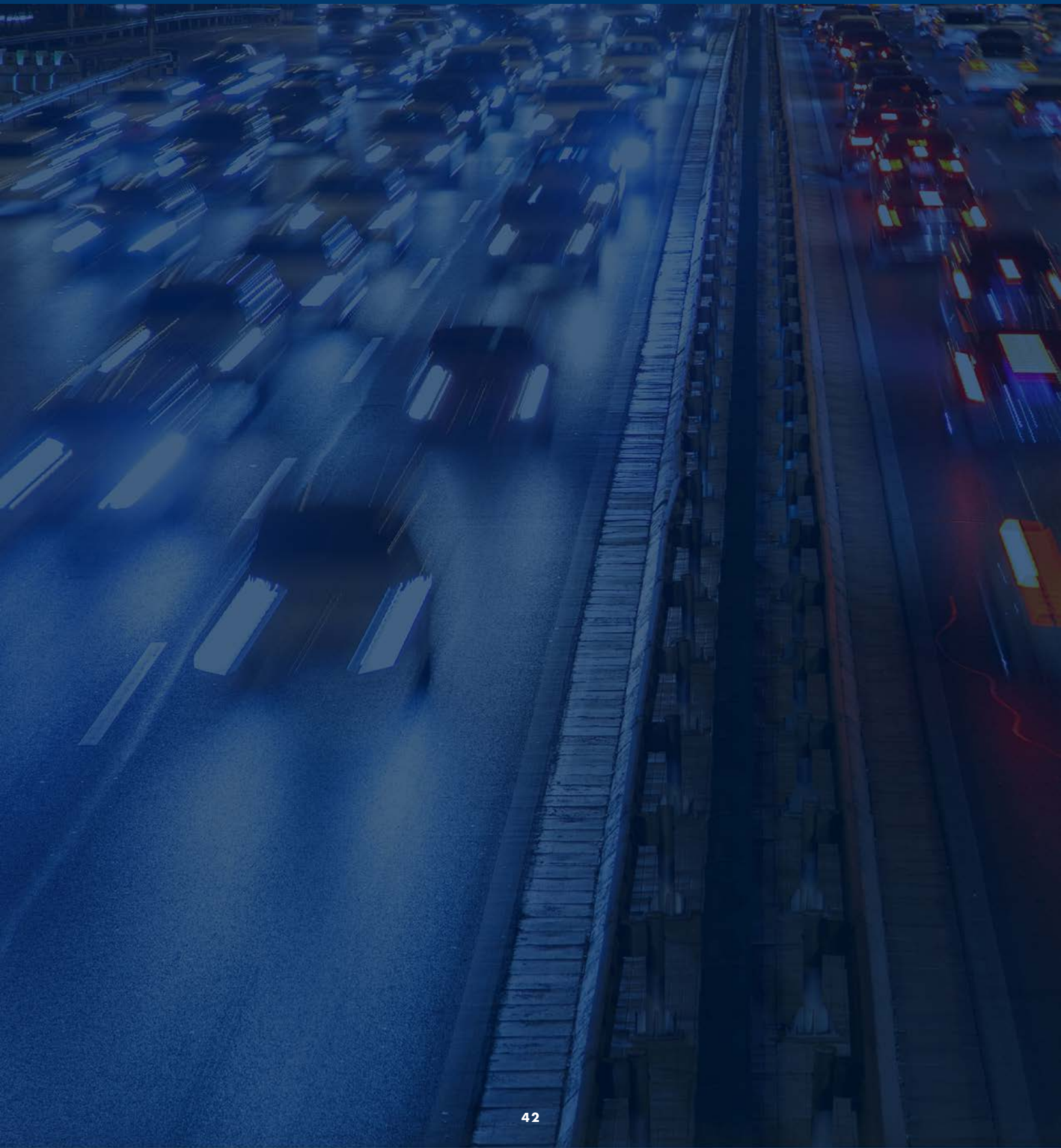
FIGURE 8: SAMPLE ELECTRICITY BILL FROM AN EVGO CUSTOMER

ENERGY STATEMENT		Due Date: 08/30/2019	
www.pge.com/MyEnergy			
Details of Electric Charges			
07/12/2019 - 08/12/2019 (32 billing days)			
Service For: 53102 DONNER PASS RD			
Service Agreement ID			
Rate Schedule: A10S Medium General Demand-Metered Service			
07/12/2019 - 08/12/2019			
Customer Charge	32 days	@ \$4.59959	\$147.19
Demand Charge	42.240000 kW	@ \$19.99000	\$844.38
Energy Charges	691.120000 kWh	@ \$0.17848	123.34
Energy Commission Tax			0.21
Total Electric Charges			\$1,115.12
Service Information			
Meter #			
Total Usage			691.120000 kWh
Serial			Q
Rotating Outage Block			3D

Source: EVgo, May 2020

40 Jonathan Levy, Isabelle Riu, and Cathy Zoi, *The Costs of EV Fast Charging Infrastructure and Economic Benefits to Rapid Scale-Up* (Los Angeles, CA: EVgo, May 18, 2020), https://www.evgo.com/wp-content/uploads/2020/05/2020.05.18_EVgo-Whitepaper_DCFC-cost-and-policy.pdf.

APPENDIX



Acronyms & Abbreviations

ADA	Americans with Disabilities Act
AHJ	Authority having jurisdiction
BEV	Battery electric vehicle
CSP	Charging service provider
DCFC	Direct current fast charging/charger
EV	Electric vehicle
EVSE	Electric vehicle supply equipment
EVSP	Electric vehicle service provider
FHWA	Federal Highway Administration
ICCT	International Council on Clean Transportation
ICE	Internal combustion engine
kVA	Kilovolt ampere
kW	Kilowatt
kWh	Kilowatt-hour
L1	Level 1 charging
L2	Level 2 charging
MJ	Megajoule
MUTCD	Manual on Uniform Traffic Control Devices
Mw	Megawatt
PG&E	Pacific Gas and Electric
PEV	Plug-in electric vehicle
PHEV	Plug-in hybrid electric vehicle
RFID	Radio frequency identification
RMI	Rocky Mountain Institute
ROI	Return on investment
SCE	Southern California Edison
TOU	Time-of-use
VAC	Volts alternating current

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About the Electric Vehicle Council

The Electric Vehicle Council is a non-advocacy organization whose mission is to coordinate the efforts of organizations actively engaged in supporting the deployment of EV charging infrastructure. The EV Council works to distribute existing research and education materials to amplify and enhance its value to the market, as well as conducts original research to fill gaps in knowledge and further educate interested stakeholders concerning the opportunities, challenges, and successful strategies associated with the installation and operation of EV charging stations.

For more information on the Electric Vehicle Council and a current list of members, please visit: fuelsinstitute.org/Councils/Electric-Vehicle-Council

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The Fuels Institute, founded by NACS in 2013, is a 501(c)(4) non-profit research-oriented think tank dedicated to evaluating the market issues related to vehicles and the fuels that power them. By bringing together diverse stakeholders of the transportation and fuels markets, the Institute helps to identify opportunities and challenges associated with new technologies and to facilitate industry coordination to help ensure that consumers derive the greatest benefit.

The Fuels Institute commissions and publishes comprehensive, fact-based research projects that address the interests of the affected stakeholders. Such publications will help to inform both business owners considering long-term investment decisions and policymakers considering legislation and regulations affecting the market. Research is independent and unbiased, designed to answer questions, not advocate a specific outcome. Participants in the Fuels Institute are dedicated to promoting facts and providing decision makers with the most credible information possible so that the market can deliver the best in vehicle and fueling options to the consumer.

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